GENERAL LIBRARY
SEP 13 1919

# SCIENCE

NEW SERIES
VOL. L, NO. 1289

FRIDAY, SEPTEMBER 12, 1919

SINGLE COPIES, 15 CTS.
ANNUAL SUBSCRIPTION, $5.00


# BLAKISTON

## MARSHALL—Microbiology

*2d Edition, Revised and Enlarged. 186 Illustrations. Flexible Cloth, Round Corners. $3.00 Postpaid*

A Text-book of Microörganisms, General and Applied, by various writers. Edited by CHARLES E. MARSHALL, Professor of Microbiology and Director of Graduate School, Massachusetts Agricultural College, Amherst. Discusses Morphology, Culture and Physiology of Microörganisms, including Nutrition and Metabolism, Physical Influences; Bacteriology of Dairy, Soil, Water Supplies, Sewage Disposal, Air, Special Manufactures, Diseases of Man, Animals and Plants.

## CONN—Agricultural Bacteriology

*3d Edition, Revised. 63 Illustrations, 12mo. Cloth, $2.00 Postpaid*

A Study of the Relation of Germ Life to the Farm, with Laboratory Experiments for Students. Including Microörganisms of Soil, Fertilizers, Sewage, Water, Dairy Products, Miscellaneous Farm Products and of Diseases of Animals and Plants. By H. W. CONN, Ph.D., Formerly Professor of Biology, Wesleyan University, Middletown, Connecticut.

Revised by HAROLD JOEL CONN, Associate Bacteriologist, N. Y. Agricultural Experimental Station.

## RODDY—Medical Bacteriology

*46 Illustrations, 8 in Colors. 8vo. Cloth, $2.50 Postpaid*

A text-book for beginners and laboratory guide for medical practitioners and pharmacists. By JOHN A. RODDY, M.D., Associate in Hygiene and Bacteriology, Jefferson Medical College; Chief Assistant, Department of Clinical Medicine, Jefferson Hospital, Philadelphia.

## MACNEAL—Pathogenic Microorganisms

*213 Illustrations. 12mo. Flexible Cloth, Round Corners. $2.50 Postpaid*

An introduction to the study of pathogenic microörganisms. Part I is devoted to technical procedures; Part II general biology of microörganisms, and Part III discusses individual microbes. By WARD J. MACNEAL, M.D., Professor of Pathology and Bacteriology, New York Post-Graduate Medical School.

## P. BLAKISTON'S SON & CO.

PUBLISHERS 1012 Walnut Steeet PHILADELPHIA

## The University of California Press

**Berkley, California** **280 Madison Avenue, New York**

### STUDIES ON THE PARASITES OF THE TERMITES

**By CHARLES ATWOOD KOFOID AND OLIVE SWEZY**

*(116 pages, 14 plates, 8 figures in text)*

I. On *Streblomastiz strix*, a Polymastigote Flagellate with a Linear Plasmodial Phase . . . . . .25

II. On *Trichomitus termitidis*, a Polymastigote Flagellate with a Highly Developed Neuromotor System . . . . . .25

III. On *Trichonympha campanula* Sp. Nov. .75

IV. On *Leidyopsis sphaerica*, Gen. Nov., Sp. Nov. . . . . .25

The University of California Publications deal with various lines of scientific investigations: Agricultural Sciences, American Archaeology and Ethnology, Botany, Economics, Education, Entomology, Geography, Geology, History, Pathology, Philology, Philosophy, Physiology, Psychology, and Zoology.

**Complete Lists of Titles and Prices will be sent on Request**

## Elementary Biology

### An Introduction to the Science of Life

**By BENJAMIN CHARLES GRUENBERG**

*Head of the Biology Department, Julia Richman High School, New York*

***Just Published***

Man's conquest of his surroundings through the application of more and more trustworthy knowledge is the leading motive of the book.

Written particularly for the first or second year of the high school, or for any high school grade, the style and character of the book nevertheless fit it for a variety of uses. It furnishes a sound basis for later studies in agriculture, psychology, or in any specialized branch of biology.

## Ginn and Company

**Boston New York Chicago London**

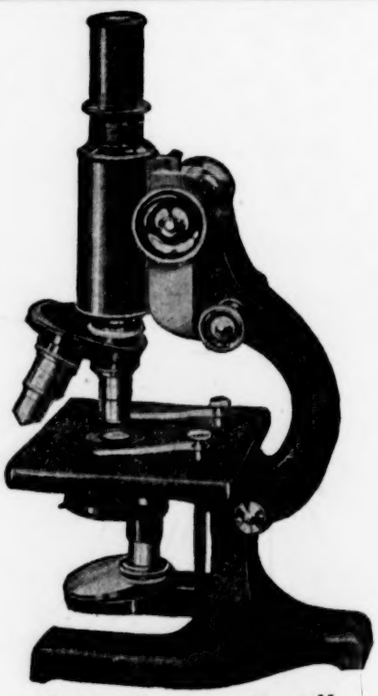
## Spencer Microscopes Nos. 44 and 64

Are now supplied with our **NEW 4** Millimeter **OBJECTIVE** made from a new formula from optical glass made in our own factory. This objective not only gives superb definition but has a

**Long Working Distance**

nearly twice that of the old objectives of equal magnification.

Now that we are released from war work, we are again in position to give to our customers the prompt service which has characterized our business in former days.



**Spencer Microscope No. 44H**

SPENCER BUFFALO U.S.A.

## SPENCER LENS COMPANY

**BUFFALO, N. Y.**

SPENCER BUFFALO U.S.A.

# SCIENCE

FRIDAY, SEPTEMBER 12, 1919

CONTENTS

*Not Ten but Twelve:* DR. WILLIAM BENJAMIN SMITH ..... 239

*A National Institute of Nutrition:* DR. H. P. ARMSBY ..... 242

*The Osler Presentation:* LIEUTENANT COLONEL F. H. GARRISON ..... 244

*Scientific Events:—*
*Medical Education and Practise in China; Mineral Production of the United States in 1918; Fifth National Exposition of Chemical Industries* ..... 246

*Scientific Notes and News* ..... 248

*University and Educational News* ..... 251

*Discussion and Correspondence:—*
*A Possible Source of Cosmical Energy:* DR. INGO W. D. HACKH. *Imperfect Stage of Leptosphæria tritici of Wheat:* L. W. DURRELL ..... 252

*Scientific Books:—*
*A Brief Survey of Some Recent Chemical Literature:* PROFESSOR H. P. TALBOT ..... 253

*Organization of the American Section of the International Geophysical Union:* DR. HARRY O. WOOD ..... 255

*Special Articles:—*
*Resemblances between the Properties of Surface-Films in Passive Metals and in Protoplasm:* PROFESSOR RALPH S. LILLIE ..... 259

*Societies and Academies:—*
*The North Carolina Academy of Science:* BERT CUNNINGHAM ..... 262

MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

## NOT TEN BUT TWELVE!

THERE has come to my hands a petition in the form of an open "Letter to Lord Balfour" ("Chairman on Weights, Measures, Coinage, etc."), circulated in the name of the "World Trade Club," and calling upon "United States American President, His Excellency Woodrow Wilson, United States American Congress, etc.," and "British Premier, His Excellency David Lloyd George, Houses of Parliament, etc.," for "legislation, promulgation, Orders in council that will bring about the exclusive use of Meter-Liter-Gram by the United States of America" and "The British Isles."

As the matter is of far-reaching scope and prime importance, may I be allowed a word of earnest protest.

The reasons advanced in the fifteen pages of argument, on disregarding the ill-advised and ill-founded appeal to national prejudice against the alleged Germanic character of our present system (or chaos), amount merely to the oft-repeated affirmation that the metric system, being consistently decimal, is far simpler, more convenient, and time-saving than any non-decimal system, since reductions from unit to unit are made merely by shifting the point, as in dollars and cents. That herein lies a certain very considerable convenience is not denied in any quarter and needs no detailed exposition. Also the advantage of world-wide uniformity in weights, measures, and coinage are plain and uncontested. But this latter fact is no reason for the Anglo-Saxon world to pass over to the Latin-German system, rather than for the latter to yield to some far superior system of the former. While conceding all that may be said with any show of reason in favor of a decimal system, we must not forget nor disguise the very grave disadvantages that inhere ineradicably in it, especially in its cum-

brous expression of many simple, important, and frequent fractions, as 1/3, 1/4, 1/6, 1/8, 1/9, 1/12, etc. We protest most earnestly against the adoption of the Latin-German system, not because it is not better than our present lack of all system, but because such adoption would *postpone perhaps forever the introduction of a far superior system,* which is a capital desideratum of our modern civilization and life. The meter-liter-gram is at least in some ways comparatively good, but the good is the enemy of the best, with which only we can rest content, and it would be an infinite blunder to establish and eternize such a defective system as the M.L.G. when it is almost as easy—at least, when it is entirely possible—to introduce and establish once and for all time the best system that the nature of number and of the human mind permits.

This best of numerical systems is not the ten-system (which is recommended only by the fact that man has ten fingers and ten toes!) but the twelve-system, whose virtues are imbedded in the nature of number itself. Its notation requires at once the introduction of *two new symbols,* one for ten, one for eleven, which may be made as pretty and simple as you will, but the initials *t* and *e* will answer all present purposes. We shall have then the ciphers: 1, 2, 3, 4, 5, 6, 7, 8, 9, *t, e.* Twelve is then to be written 10, and we shall have the next set; 11, 12, 13—19, 1*t,* 1*e,* 20—to be read tel-one, tel-two, tel-three, . . ., tel-nine, tel-ten, tel-len, *twentel.* The reasons for such names are obvious, *tel* and *len* are natural simplifications of twelve and eleven. Our present forms, such as sixteen, seventeen, which read the numbers 16, 17 *backwards,* are a stumbling-block to beginners, hindering and confusing them to no purpose whatever. Twentel (20) equals of course our present twenty-four. Similarly thirtel-one, etc., fortel, fiftel, sixtel (sistel), sentel (for seventel), eightel, ninetel, tentel, lentel, teltel. This last, 100, equal to our present 144, is of course the second power of the base twelve (10), and should have some appropriate name, as *dipo,* or *two-po,* or whatever may seem best, and similarly the higher powers, as 1000(1728), 10,000(20,736, etc.). We see here at once the greater *power* of this system; with four figures it expresses numbers up to 20,735 (e e e e in the twelve-system), more than twice as many as are so expressible at present—an advantage that steadily increases with the numbers, and shows itself clearly in logarithmic and other tables, where, with the same number of figures, the accuracy of expression would be sensibly higher. Thus, a unit in the sixth decimal place now signifies a millionth, in the Tel-system it would mean about a three-millionth. In the billions, the Tel-notation economizes one place.

Among the many advantages shared by this system with no other, the chief is the high factorability of the base twelve, divisible exactly by 2, 3, 4, 6, and simply related to 8 and 9. Thence result extremely simple expressions for the principal fractions:

1/2 = .6
1/3 = .4
1/4 = .3
1/6 = .2
1/8 = .16
1/9 = .14
one twelfth = .1
1/14 = .09
1/16 = .08
1/20 = .06, etc.

The fractions 1/5, 1/7 one tenth, one eleventh (111 . . . .) remain interminate series, but for them we have little practical use. With the foregoing compare the current decimal expressions for the fundamental constantly recurring fractions:

1/2 = .5
1/3 = .33333 - - -
1/4 = .25
1/6 = .16666 - - -
1/8 = .125
1/9 = .111
one twelfth = .08333 . . .

and the great superiority of the tel-system becomes evident.

The multiplication table[1] becomes markedly simplified. No one has any trouble now in multiplying by 5, because of its simple cycle, 5, 0 (as in 5, 10, 15, 20, etc.): 4 has the much longer, more involved cycle, 4, 8, 2, 6, 0, (as in 4, 8, 12, 16, 20, etc.); 6 has the cycle 6,

2, 8, 4, 0 (6, 12, 18, 24, 30); 8, the cycle 8, 6, 4, 2, 0. Compare with these the cycles in the Tel-system: 2(2, 4, 6, 8, t, 0), 3(3, 6, 9, 0), 4(4, 8, 0), 6(6, 0), 8(8, 4, 0), 9(9, 6, 3, 0), and the surpassing simplicity of this system is again apparent. A child will learn this multiplication table with much less effort than

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | *t* | *e* |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 4 | | | | | | | | | |
| 3 | 6 | 9 | | | | | | | | |
| 4 | 8 | 10 | 14 | | | | | | | |
| 5 | *t* | 13 | 18 | 21 | | | | | | |
| 6 | 10 | 16 | 20 | 26 | 30 | | | | | |
| 7 | 12 | 19 | 24 | 2*e* | 36 | 41 | | | | |
| 8 | 14 | 20 | 28 | 34 | 40 | 48 | 54 | | | |
| 9 | 16 | 23 | 30 | 39 | 46 | 53 | 60 | 69 | | |
| *t* | 18 | 26 | 34 | 42 | 50 | 5*t* | 68 | 76 | 84 | |
| *e* | 1*t* | 29 | 38 | 47 | 56 | 65 | 74 | 83 | 92 | *t*1 |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| 2 | 4 | | | | | | | |
| 3 | 6 | 9 | | | | | | |
| 4 | 8 | 12 | 16 | | | | | |
| 5 | 10 | 15 | 20 | 25 | | | | |
| 6 | 12 | 18 | 24 | 30 | 36 | | | |
| 7 | 14 | 21 | 28 | 35 | 42 | 49 | | |
| 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | |
| 9 | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 81 |

Compare these two multiplication tables. In the ten-table the end digits are: 0, 4 times; 1, 2 times; 2, 5 times; 3, 1 time; 4, 6 times; 5, 4 times; 6, 6 times; 7, 1 time; 8, 5 times; 9, 2 times. In the tel-table the end-figures in the corresponding products are: 0, 8 times; 1, 2 times; 3, 3 times; 4, 6 times; 6, 6 times; 8, 4 times; 9, 4 times; *t*, 2 and *e* each 1 time; 5 and 7, not at all, though each occurs once of course, in the products of e. Notice the much greater simplicity, due to their absence and to the presence of 0, 8 times. Notice also the simplicity in the squares, and the double central symmetry in 1, 4, 9, 4, 1, 0, 1, 4, 9, 4, 1, and compare with the 1, 4, 9, 6, 5, 6, 9, 4, 1 of the ten-table, also an anagram but with only single symmetry, and with 5 different digits against only 4 in the tel-system, which is thus notably simpler. the ten-table, and will find the range of its power and the scope of his attainment just 44 per cent. greater (since 100 in the tel-system = 144 in the ten-system).

The year is divided into twelve months, and no other division is likely within any forseeable time. Accordingly, in time-reckoning the advantages of the tel-system are obvious. In this notation the number of days in the year is 265. To each month we should by all means assign the same number of days, thirty (30) as now or twentel-six (26) in the tel-system: that is, 260 month-days in all; the remaining 5 should be extra-mensual, legal holidays, easily and instructively distributable over the year, with a sixth such in leap years. Monthly and annual accounts and rates would be turned into each other by merely moving the point one place to right or left. If one received $100 a month, one would receive $1,000 a year; if the interest rate was 6 (per dipo) per year, it would be .6 per month. Similarly the day is already divided into (twice) twelve hours, that is, 20 in the tel-system. The circle (or round angle) is now divided into 360 degrees (or 250 in the tel-system); this Babylonian division is unfortunate but may be easily conformed to the divisions of the clock-face into twelve parts, each of these divided into twelve (stretches of 5 minutes or of 2 1/2 degrees), each of these into twelve again, and so on. With our established time-divisions the ten-system can never be harmonized.

The better unit of coinage is the American quarter, the English shilling (German mark). The dollar is too large, a fact in some measure responsible for the sinful and ruinous extravagance of American life. The shilling is already divided into twelve pence, a division that admits of no improvement; it remains only to be consistent and to coin the twelve-shilling piece (a convenient coin, which might be named twilling or tel-quar); with its fractions and multiples, which Anglo-American commerce would spread all over the earth. So, too, the foot is already divided into twelve inches. To convert inches and feet into each other, it would be necessary only to move the point.

The meter has no superiority over the yard;

if the latter be taken as standard, it should be divided into twelfths (or telths), and these again into twelfths, etc. The mile might be slightly reduced to 1,728 yards (in the tel-system 1,000 yards, 3,000 feet). All such details and all proper preliminaries to the passage from ten to twelve could be worked out by scientific committees appointed for the purpose, once the number twelve is laid at the base of our numeration, notation and all forms of measurement—a position for which it is uniquely fitted.

One and only one objection can be made to this proposal, namely, that it is impractical, infeasible and visionary. We dare not answer with the favorite Scripture, "Where there is no vision, the people perish," for this sentiment alas! is foreign to the Hebrew proverb. But the objectors themselves reject with scorn the similar objection to the introduction of the metric system, that it is impractical and visionary and could only with great difficulty be effected. It is the stock objection of all conservatism, the objection that confronts every effort to rationalize, humanize, beautify, glorify and justify our life on earth, the objection that it can not be done! The same has been said of a hundred proposals, all declared unrealizable, and all now actually realized. It may be hard to answer Zeno's arguments against the possibility of motion, but it is none the less easy to move! So it will be with the change from ten to twelve. Attempted, it will be accomplished. Not in a day or a year, but at most in a generation. Let the children be taught the tel-system year after year. The time necessary to learn it will be quite inconsiderable. Once learned, it will also be loved. In the meantime scientific commissions can go over the whole ground carefully and prepare the way in the wilderness and level up in the desert a road for the age to come. When the change is finally carried into effect, the jar of switching off the ten-track to the twelve-track will be much less severe than we now imagine. But it will bring incalculable blessings to all future generations. The great giant arithmetic will be shorn of half his terrors. It is very common in these loud-mouthed days to make Brobdingnagian pretensions. We are told that each of a score of trifles (base-ball among them) won the war, when each made only a paltry contribution to the collective result. So we are assured that each of many things would have abridged the war by months or years. The World Trade Club informs us that had Congress adopted the "meter-liter-gram legislation before Congress (1904), the war would have been shortened two years." If a few other such things had been done, perhaps the war would have been stopped like Buck Fanshaw's riot, before it was started or even imagined! As such indebtedness heaps up on all sides, one is reminded of the famous couplet:

> Owen More has run away,
> Owin' more than he can pay.

We are further assured that

> Clyde Wolfe, Master Mathematician, University of California, writes: A conservative estimate is that the exclusive use of meter-liter-gram would shorten the time of teaching arithmetic to the average child by 2 years.

If so, then the substitution of twelve for ten as a base ought to shorten it by at least four years. No such claim is made here, but it is affirmed that a very large and sorely needed saving of time and energy would be effected, and that if the introduction of the thoroughly rational twelve-system should be supplemented by the adoption of a thoroughly rational alphabet, with one-to-one correspondence of sign and sound, then would the words of the English language indeed be winged and fly over all the earth, then would our Anglo-American civilization lead the van of progress, and its commerce would fulfil the boast of its poet:

> Trade is the golden girdle of the globe.

William Benjamin Smith

## A NATIONAL INSTITUTE OF NUTRITION

In a recent issue of Science (August 1, 1919) Lusk calls attention to a reconstruction problem which seems in danger of receiving less consideration than its fundamental significance demands, viz., the food problem, vital

to the very existence of civilization, and proposes as one agency for its study the foundation of a national laboratory of human nutrition. The importance of the subject is such that Lusk's proposal seems to invite discussion on the part of those more or less directly interested in the science of nutrition and its utilization for the benefit of humanity. Accordingly I venture to submit for consideration certain personal notions regarding the kind of organization which is desirable and as to steps which might be taken to secure it.

It is to be remarked in the first place that the subject of national (and still more of international) nutrition is a very broad one, involving much more than the mere laboratory study of the laws of human nutrition, important as that is. It is a two-fold subject, including the economical production of food as well as its efficient utilization. The farmer, like other producers, rightly desires a reasonable reward for his services. The interests of the consuming public demand a liberal food supply at prices low enough to ensure the adequate nourishment of all classes of the community. It should be the aim of any national organization of students of nutrition to contribute to the harmonizing of these apparently conflicting interests and to demonstrating that in the large view they are not antagonistic. Accordingly I feel inclined to broaden the caption of Lusk's article and to speak provisionally of a national institute of nutrition.

In the organization of such an institute there are certain general principles which should, as I think, control.

1. It should not be burdened with executive duties. Questions of transportation, marketing, cold storage, profiteering, price control, rationing, etc., should be recognized as subjects lying outside its field and with which students of nutrition as such are not specially qualified to deal. In brief, it should not be an executive department of the government nor have the functions of a food administration but should supply to legislative and executive authorities the scientific data upon which any successful measures of food policy must be based.

2. It should be distinctly national in character and should be a means of integrating and coordinating without controlling the activities of the various existing agencies of investigation. It should be so constituted that it may represent the United States officially in any international conference involving questions of nutrition.

3. It should be under the control of scientific men and not subject to the vagaries of legislative bodies nor dependent upon them for annual appropriations with the accompanying pressure to emphasize popular and spectacular work. This is an additional reason for not making it an executive department.

The natural organizing authority of such an institute as is here contemplated would seem to be the National Research Council. Both because of its intimate relations with the National Academy of Sciences and by virtue of the executive order of May 11, 1918, it is recognized as a national body representing the organized scientific activities of the United States. Moreover, the Research Council has already taken a first step in the direction indicated by authorizing the appointment of a committee on food and nutrition. Presumably the purpose has been to select a committee representative of the nutrition investigators of the country while the matter is still sufficiently fluid to permit of any necessary modifications. Here, as it seems to me, is an ideal body to constitute a board of control of the proposed institute. It would determine, subject to the approval of the National Research Council, the general policy of the institute, while the immediate administration would naturally be confided to a director selected or nominated by the governing body and responsible to it but given large discretionary powers.

It would be premature to attempt to outline in any detail the field of work of a national institute of nutrition but it would seem that it would rather naturally divide itself into four sections:

I. *Statistical.*—What are the total food requirements of the United States? What is the actual food consumption and how much of this is avoidable waste? How is food consumption and food waste distributed among different classes of

the population? What is our total food production, and can it be modified so as to secure more efficient utilization? Information on these and related questions should be kept up to date and available, using present statistical data so far as they suffice and collecting additional data if needed.

II. *Physiological.*—A scientific study of problems of human nutrition, such as those instanced by Lusk and others which might be added. The results of these investigations would afford the indispensable groundwork of the statistical studies just mentioned.

III. *Agricultural.*—A broad study of the economy of food production in the light of the food requirements of the nation and from the standpoint of the mutual interests of producer and consumer. All the innumerable problems of plant and animal nutrition would find their place here, as well as broader questions regarding the relative economy of production of animal and vegetable foods and of different classes of each and of the most economical level of production under varying conditions.

IV. *Extension and Publicity.*—A very important function of the institute would be to bring the results of its work effectively to the attention of the community and of legislatures and executives, and to impress on them its vast economic and social importance.

It goes without saying that such an institute should cultivate most cordial relations with existing agencies. It should supplement, not supplant. If wisely and conservatively directed it might do much to bring about cooperation and coordination in the activities of extension departments, of nutrition laboratories, of experiment stations, and of the research and statistical divisions of the department of agriculture, so far as they relate to nutrition. Whether its objects could be sufficiently attained in this way or whether its policy should include in addition the establishment of laboratories of its own would be a question for the decision of the board of control.

Finally, as regards financial support, I believe that if as the result of free discussion and comparison of views a scheme can be worked out which has the approval of the scientific men of the country and which commends itself to the National Research Council as practicable and as promising material benefit to the public, past experience warrants the belief that the necessary funds will be forthcoming.

H. P. Armsby

## THE OSLER PRESENTATION

On July 11, 1919, Sir William Osler, Regius professor of medicine in the University of Oxford, was honored by the presentation of two anniversary volumes, made up of medical contributions by English and American colleagues, commemorating his seventieth birthday (July 12). The presentation was made by Sir Clifford Allbutt at the house of the Royal Society of Medicine on behalf of some 150 subscribers and contributors, in the presence of a large and distinguished audience. The plan of a birthday memorial originated at Oxford, and was successfully carried through by a committee with Dr. William H. Welch as chairman, Dr. Casey A. Wood, as secretary and Dr. Henry Barton Jacobs as treasurer. In the early stages, the work was financed through the energy and initiative of Colonel Casey A. Wood, and the manuscripts were edited and carried through the press by Drs. Charles L. Dana (New York) and Charles Singer (Oxford).

Sir William Osler, the recipient of this unusual tribute, is looked up to and honored everywhere as a leader of British and American medicine. In succession, he has held the chairs of medicine at McGill (1874), the University of Pennsylvania (1884), the Johns Hopkins University (1889) and Oxford (1904). His eminence in clinical medicine is based upon an extraordinary knowledge of pathology, acquired in his early days at Montreal, and upon the fact that he has taught medicine to students inductively, away from the textbooks, and by direct contact with the sick in the wards. At an early age (1874) he described the blood-platelets, which he was the first to define as the third corpuscle of the blood and in relation to the formation of thrombi. He also discovered the parasite of verminous aneurism (*Filaria Osleri*), first pointed out the relation between mycotic

aneurism and mycotic endocarditis, first described the ball-valve thrombus at the mitral orifice, the visceral complications of erythema multiform (1895), chronic cyanosis with polycythemia (1895), the erythematous spots in malignant endocarditis (1908), and other clinical minutiæ recorded in the bibliography of 730 titles in the Osler number of the *Bulletin of the Johns Hopkins Hospital* (July, 1919). These discoveries are all the more remarkable, in that Osler's life has not been that of the laboratory physician, but one of absolute and exclusive devotion to his patients and his pupils. No other physician has been such an universal friend to his colleagues, to students and to the younger members of his profession. He enjoys the esteem and affection of the entire medical profession.

An account of the presentation is given in the *British Medical Journal* (July 19, p. 80):

In presenting the volumes, Sir Clifford Allbutt said:

In these volumes we hope you will find the kind of offering from your fellow workers which will please you best—immaterial offerings indeed, but such as may outlive a more material gift. As to you we owe much of the inspiration of these essays, and as in many of their subjects you have taken a bountiful part, so by them we desire to give some form to our common interests and affections.

We pray that health and strength may long be spared to you and to her who is the partner of your life; and that for many years to come you will abide in your place as a Nestor of modern Oxford, as a leader in the van of medicine, and as an example to us all.

In reply Sir William Osler said:

*Sir Clifford Allbutt, Ladies and Gentlemen:* As the possessor of a wild and wagging tongue that has often got me into trouble, I thought it would be better on such an occasion to make full notes beforehand of what I wanted to say. Two circumstances deepen the pride a man may justly feel at this demonstration of affection by his colleagues on both sides of the Atlantic—one, that amid so much mental and physical tribulation my friends should have had the courage to undertake this heavy two-volume task, and the other, that this honor is received at the hands of my brother Regius, a friend of more than forty years. (Applause.) There is no sound more pleasing than one's own praises, but surely an added pleasure is given to an occasion which graces the honorer as much as the honored. To you, Sir Clifford, in fuller measure than to any one in our generation has been given a rare privilege; to you, when young, the old listened as eagerly as do now, when old, the young. (Applause.) Like Hai ben Yagzan of Avicenna's allegory, you have wrought deliverance to all with whom you have come in contact.

To have enshrined your gracious wishes in two goodly volumes appeals strongly to one the love of whose life has been given equally to books and to men. A glance at the long list of contributors, so scattered over the world, recalls my vagrant career—Toronto, Montreal, London, Berlin and Vienna as a student; Montreal, Philadelphia, Baltimore and Oxford as a teacher. Many cities, many men. Truly with Ulysses I may say, "I am a part of all that I have met."

Uppermost in my mind are feelings of gratitude that my lot has been cast in such pleasant places and in such glorious days, so full of achievement and so full of promise for the future. Paraphrasing my lifelong mentor—of course I refer to Sir Thomas Browne—among multiplied acknowledgment I can lift up one hand to heaven that I was born of honest parents, that modesty, humility, patience and veracity lay in the same egg, and came into the world with me. To have had a happy home in which unselfishness reigned, parents whose self-sacrifice remained a blessed memory, brothers and sisters helpful far beyond the usual measure—all these make a picture delightful to look back upon. Then to have had the benediction of friendship follow one like a shadow, to have always had the sense of comradeship in work, without the petty pinpricks of jealousies and controversies, to be able to rehearse in the sessions of sweet, silent thought the experiences of long years without a single bitter memory—to have and to do all this fills the heart with gratitude. That three transplantations have been borne successfully is a witness to the brotherly care with which you have tended me. Loving our profession, and believing ardently in its future, I have been content to live in it and for it. A moving ambition to become a good teacher and a sound clinician was fostered by opportunities of an exceptional character, and any success I may have attained must be attributed in large part to the unceasing kindness of colleagues and to a long series of devoted pupils whose success in life is my special pride.

To a larger circle of men with whom my con-

tact has been through the written word—to the general practitioners of the English-speaking world—I should like to say how deeply their loyal support has been appreciated. Nothing in my career has moved me more, pleased me more, than to have received letters from men at a distance—men I have never seen in the flesh—who have written to me as a friend. And if in this great struggle through which we have passed sorrow came where she has not been before, the blow was softened by the loving sympathies of many dear friends. And may I add the thanks of one who has loved and worked for our profession, and the sweet influences of whose home have been felt by successive generations of students?

To the committee and the editors I am deeply indebted for the trouble they have taken in these hard days, and to the publisher, Mr. Paul Hoeber, for his really pre-war bravery; and our special thanks are due to you, kind friends—and in saying this also I would associate Lady Osler with myself—who have graced this happy ceremony with your presence.

The ceremonies terminated with the proposal of a vote of thanks to Sir Clifford Allbutt by Sir D'Arcy Power, and concluding remarks by Sir Donald McAlister and Sir Clifford Allbutt.

F. H. Garrison
Army Medical Museum

## SCIENTIFIC EVENTS

### MEDICAL EDUCATION AND PRACTISE IN CHINA

The *Journal* of the American Medical Association calls attention to the fact that under the influence of several American and other missionary boards and by the aid of such prominent American medical schools as Harvard, Yale and the University of Pennsylvania, and with the generous financial assistance of the China Medical Board, which was organized by the Rockefeller Foundation, there has been great medical progress in China in recent years, and there are twenty-six medical schools in China. Five of these at present are members of the Association of Medical Colleges of China. Membership in this association is limited to colleges, which provide a four-year medical course, and which require for admission two or more years of college work, including courses with laboratory work in physics, chemistry and biology.

Two practically new medical schools, including premedical departments, are being erected as Peking and Shanghai by the China Medical Board of the Rockefeller Foundation. These are the Peking Union Medical College and the Shanghai Medical School. The plan is to make these equal to any other medical schools in the world in buildings and equipments, as well as in hospital facilities and in educational standards.

The Rockefeller Foundation is also aiding financially other medical schools in China, particularly the Shantung University School of Medicine at Tsinan, The Hunan-Yale College of Medicine at Changsha, and the medical schools of Nankin, Canton, Soochow and elsewhere.

A strong appeal is still being made for medical missionaries. In China, with an estimated population of more than 400,000,000 people, including Manchuria and Mongolia, there are said to be at present only 2,000 scientifically trained physicians. It is stated that at the end of 1917 there were 351 foreign medical missionaries who had working with them 212 foreign physicians. During that year these physicians cared for about 120,000 hospital inpatients. Although large, these figures do not begin to touch the great needs of medical service in that country.

The *Journal* notes that all civilized nations are interested in helping to provide better medical service in China for the sake of their own people, if not for the sake of the Chinese, because China is at present the source of many of the epidemics which are liable to sweep over the entire world. It is for the medical practise of the entire world to combat disease wherever it is found by checking it at its very source. If any physician would prefer to have a large practise regardless of the financial income involved, he would have no difficulty in securing it in China, where there is indeed great need of skilled medical service.

### MINERAL PRODUCTION OF THE UNITED STATES IN 1918

The Department of the Interior has issued a preliminary report on the mineral produc-

tion of the United States in 1918 for the purpose of making public as soon as possible the statistics collected by the U. S. Geological Survey for that year. The statistics given for most commodities are final; those for a few are only estimates based on incomplete returns; but on the whole the report gives a fairly complete record of the mineral output of the country during the year.

The total value of the minerals produced was about $5,526,000,000, more than half a billion dollars in excess of the value recorded for 1917, but the total quantity produced was less. The output of fuels was greater than in 1917, though somewhat less anthracite coal was marketed. The increase in the quantity of coal marketed was about 5 per cent. but the increase in value, due to higher prices, was more than 17 per cent. It is significant that though the increase in the quantity of petroleum marketed was only a little more than 4 per cent. the increase in value was over 32 per cent.

The value of the metals produced was about 3 per cent. greater in 1918 than in 1917. The figures show that less iron ore and steel were produced, but here again values were higher. A little more pig iron was made, though the quantity shipped was less. Copper and zinc not only in themselves but as the components of brass are perhaps next in importance to iron in the world's industry to-day, and in 1918 they stood high on the list of war metals. A little more copper but less zinc was produced, and the values of both were lower, that of zinc falling about 25 per cent. The output of the war metals manganese and chromite, used in hardening steel, was greater than in any preceding year. Chromite increased 88 per cent. in quantity and 275 per cent. in value over 1917, and the increases in manganese ore were 136 and 100 per cent., respectively. Less gold and silver were mined than for many years. Though the price of silver rose from 81 cents an ounce in 1917 nearly to 97 cents in 1918, the increase was not enough to cover the increased cost of mining.

The output of building material—clay products, building stone, cement, lime, gypsum—showed a great decline.

The domestic productions of potash in 1918 was 54,000 tons, an increase of 68 per cent. over the output in 1917.

## FIFTH NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES

THE forthcoming National Exposition of Chemical Industries at the Coliseum and First Regiment Armory, Chicago, during the week of September 22 to 27, inclusive, promises great benefit to American chemical industry as in the past during the war period when it contributed so directly to the advance of chemical industry in this country. The meetings of the societies which are being held in conjunction with the exposition are as follows:

American Institute of Mining and Metallurgical Engineers, September 22 to 27.

American Ceramic Society, September 24.

American Electrochemical Society, September 24 to 26.

At the opening exercises on Monday Governor Frank O. Lowden, will make the address of welcome, to which Dr. Charles H. Herty, chairman of the advisory committee will reply.

John W. O'Leary, president of the Metal Trades Association of Chicago, will give an address on "The relation of the chemist to the manufacturer." On Tuesday there will be a symposium on "America's case in chemistry," in which the speakers will be:

Technical Association of the Pulp and Paper Industry, September 24 to 27.

Chairman's address, Ellwood Hendrick.

"Dyestuffs," J. Merritt Matthews, editor, *Color Trade Journal.*

"Glassware," E. C. Sullivan, of Corning Glass Company.

"Optical glass," Harvey N. Ott, of Spencer Lens Company.

"Chemical porcelain," Herman S. Coors, of Herold China and Pottery Company.

"Essential mental minerals," J. E. Spurr, of the War Minerals Relief Committee.

"Laboratory supplies," C. G. Fischer, of Scientific Materials Company.

"Laboratory supplies," J. M. Roberts, secretary, Apparatus Makers Association of United States.

"Fine chemicals," H. T. Clarke, of Eastman Kodak Company.

Plans have been made for a joint session of the American Electrochemical Society with the Mining Institute upon the subject of "Electric steel and electric furnaces" on Wednesday of the week. This will be followed by another joint session on "Pyrometry," probably on Friday, when the following phases of the subject will be considered and discussed: Methods of Pyrometry, Industrial Pyrometry, Pyrometry and its Relation to Science. The Electrochemical Society is arranging a meeting on "Catalysis." About a hundred papers have been prepared for the meeting of the Mining Institute. Addresses of general interest include one by Dr. H. E. Howe, on "The organization and plans of the National Research Council with special reference to the Industries."

## SCIENTIFIC NOTES AND NEWS

Dr. Theodore W. Richards, professor of chemistry at Harvard University, has been elected president of the American Academy of Arts and Sciences.

Major General Wm. L. Sibert, director of the Chemical Warfare Service, U. S. A., has been made a commander of the French Legion of Honor.

Professor Alexander Smith, head of the department of chemistry at Columbia University, was granted on July 10, the honorary degree of doctor of laws by the University of Edinburgh. The following was the introduction: "Alexander Smith, B.Sc., Ph.D., director of the chemistry department of Columbia University, New York.—A most distinguished graduate of our own university, Professor Smith has risen to the rank of a super-chemist in the United States, head of a department embracing many specialized professorships, and director of one of the most important laboratories in the new world. We congratulate Columbia University on the possession of a teacher and investigator of such rare ability, and we congratulate ourselves on the opportunity of laureating an *alumnus* whose success reflects no little lustre on the institution where he received his early training."

Clarence Ousley, assistant secretary of agriculture, has resigned, leaving the Department of Agriculture on July 31. He gave as his reasons that he had finished the work for which he went to the department during the war and that he could not afford longer to hold public office. In transmitting the resignation to the president, Secretary Houston expressed deep regret that Mr. Ousley felt obliged to leave the department and stated that he was constrained to recommend the acceptance of the resignation only in deference to Mr. Ousley's wishes. The retiring assistant secretary remains in Washington.

Dr. Samuel T. Orton, of the University of Pennsylvania Hospital, has been appointed head of the new psychopathic hospital at Iowa City, which is being erected at a cost of $150,000.

Dr. M. Ozorio de Almeida has been placed in charge of the recently organized section of physiology of the Institute Oswaldo Cruz in Rio de Janeiro.

Mr. F. J. Chittenden, the head of the Wisley scientific station and laboratory, has been appointed director of the Royal Horticultural Society's Gardens at Wisley.

It is stated in *Nature* that Dr. Shaiffer, of the University of Toronto, has been appointed expert in animal husbandry to the government of Mysore. He will work under Dr. Coleman, the director of agriculture.

The Bessemer medal of the Iron and Steel Institute for the present year has been awarded to Professor F. Giolitti, of Turin.

Lord Lee, of Fareham, has been appointed to the presidency of the British Board of Agriculture and Fisheries, in succession to Lord Ernle.

Gonville and Caius College, Cambridge, has elected to a fellowship Lieutenant-Colonel C. S. Myers, who has been university lecturer in experimental psychology since 1907, and is director of the university laboratory of experimental psychology.

Dr. S. W. Patterson has been appointed director of the Eliza Hall Institute of Re-

search, in connection with the Melbourne Hospital.

NILS B. ECKBO, a member of the Forest Service since 1907, has left for Pretoria, South Africa, to assume the duties of chief of wood investigations in the Forest Department.

DR. J. P. STREET, chemist in charge of the analytical laboratory of the Connecticut Agricultural Experiment Station and recently major in the Sanitary Corps of the United States Army, has been assigned by the National Canners' Association as chief inspector for the state of Indiana.

CAPTAIN EDWARD B. STEPHENSON, Engineers, U. S. A., formerly assistant professor of physics, University of North Dakota, who has been connected with experimental and development work in sound ranging for the past two years and with the Engineer School at Camp Humphreys, Va., has been honorably discharged from the military service and employed as physicist in charge of Ranging and Camouflage Development, Office, Chief of Engineers, Washington, D. C.

LIEUTENANT COLONEL C. G. STORM, Ordnance Department, U. S. A., chief of the Research Section, Ammunition Division, has been honorably discharged from the service and is now engaged in research work with the Pennsylvania Trojan Powder Company, Allentown, Pa.

MR. H. E. HARING, for the last two years in the inspection division of the Ordnance Department, is now connected with the Bureau of Standards where he will be engaged in electrochemical research.

S. T. DANA, forest economist in the Forest Service, has been assigned to the joint congressional committee for the reclassification of salaries to assist in the formulation of a report to the congress.

PROFESSOR J. E. KIRKWOOD, head of the department of botany at the State University of Montana, has been granted leave of absence for the coming academic year. He will spend much of his time in research and study at the University of California.

DR. W. ARMSTRONG PRICE, assistant professor of geology at West Virginia University, has resigned this position to devote full time to his duties as paleontologist of the West Virginia Geological Survey.

CHARLES CONRAD ABBOTT died at Bristol, Pa., on July 27, in the seventy-seventh year of his age. Dr. Abbott was the author of "Primitive Industries" published in the early '70's, and of a number of books on natural history, including the "Archeology of the Delaware Valley."

SAMUEL T. WELLMAN, past-president of the American Society of Mechanical Engineers, well known in the iron and steel industry of the Great Lakes, died on July 11, at the age of seventy-two years.

DR. JOSEPH ZEISLER, professor of dermatology at Northwestern University since 1889, died on September 1.

GEORGE STEPHEN WEST, professor of botany in the University of Birmingham, has died at the age of forty-three years.

DR. J. GÓMEZ OCAÑA, professor of physiology at the University of Madrid, and life senator, has died, aged fifty-nine years.

THE Civil Service Commission of the state of New York will hold examinations on September 27 for the position of assistant director, Division of Laboratories and Research, State Department of Health, with a salary of $4,000. This position is open to men between the ages of thirty and forty-five years and to non-residents and non-citizens. Applicants will be rated on education, experience and personal qualifications. An interview may be required. There will also be an examination for a bacteriologist-pathologist, Division of Laboratories and Research, State Department of Health with a salary of $2,500, open to men and women, twenty-five to forty-five years of age. Candidates will be rated on a written examination relating to the duties of the position, weight 1; and on their education, experience and personal qualifications, weight 1.

HARVARD UNIVERSITY announces that Dr. Thomas M. Legge, chief medical inspector of factories in Great Britain, has been invited to

give a course of Lowell Lectures and the Cutter Lectures in Preventive Medicine for the coming year. These lectures will be given under the auspices of the school of public health of Harvard University, the division of industrial hygiene and the Massachusetts Institute of Technology. Dr. Legge will lecture in Boston on November 18 and ensuing dates upon the following subjects:

"Twenty years' experience of the notification of industrial disease."
"Twelve years' experience of workman's compensation act and industrial diseases."
"Medical supervision in factories."
"Industrial poisons and their prevention."
"Anthrax."
"Fumes and gases."
"Industrial fatigue."
"Industry as a subject for art."
"Manufacture under the medieval trade guilds."

It is stated in *Nature* that a conference of representatives of the Meteorological Services of the British Dominions is to be held in London on September 23–27, when the subjects to be considered will include the meteorological arrangements for the exchange of observations by wireless at comparatively long distances; specification of observations for the surface and the upper air with the codes for transmission; the consideration of instruments and material for the investigation of the upper air; the selection of stations of the "Réseau Mondial" for the purpose of the general climatology of the globe; the provision of current meteorological information for the main air routes of the world; cooperation in the investigation of the meteorological conditions of aerial navigation; and the trade routes and the meteorological survey of the oceans by observations transmitted by radiotelegraphy from ships. The following official meteorologists of the Dominions beyond the seas are expected to be present: Captain A. J. Bamford (director of the Meteorological Service of Ceylon), the Rev. D. C. Bates (director of the Meteorological Office of New Zealand), Mr. H. A. Hunt (director of the Weather Bureau of the Commonwealth of Australia, Melbourne), Mr. H. Knox Shaw (director of the Meteorological Service of the Public Works Ministry, Egypt), Mr. C. Stewart (chief meteorologist of the Union of South Africa), Sir Frederick Stupart (director of the Meteorological Service of Canada), and Dr. G. T. Walker (director-general of Indian Observatories).

The publication of annual or semiannual vital statistics reports was suspended in France during the war. We learn from the *Journal* of the American Medical Association that the *Journal officiel* has now printed the official statistics for 1915, 1916 and 1917 of seventy-seven departments, and the figures for 1913 are given for purposes of comparison. For the seventy-seven departments concerned, the number of births and deaths was as follows:

| | Births | Deaths |
|---|---|---|
| 1913 | 604,811 | 587,445 |
| 1914 | 594,222 | 647,549 |
| 1915 | 387,806 | 655,146 |
| 1916 | 315,087 | 607,742 |
| 1917 | 343,310 | 613,148 |

These statistics show that while in 1913 the number of births exceeded the number of deaths by 17,366, the deaths in 1917 exceeded the births by 269,838. It should be noted that these statistics do not include the eleven invaded departments in which war was waged for fifty-two months and in which the losses caused by the war were not counted, but which officially have been stated as being 1,400,000 men.

The *Journal* of the American Medical Association states that an elaborate scheme for graduate medical education in Great Britain has been formed, and it is hoped will receive support from the government. Graduate teaching is required for the following classes: (1) physicians in Great Britain who would like to spend a portion of their holidays in getting up to date in all branches of their work, or who wish to spend a few months in learning all that they can about some particular subject in which they desire to specialize, either completely or in conjunction with general practise;

(2) medical officers of the Royal Navy, the Royal Army Corps, the Royal Air Force, and the Indian and Colonial Medical Services, who have to attend postgraduate courses at stated intervals; (3) graduates from British colonies, India and Egypt, including those who have recently qualified, and wish to complete their medical education in England, and some senior men who fall into the same category as the men in Class 1; (4) graduates of allied countries, especially Americans, large numbers of whom have in the past studied in Germany and Austria, in many instances simply because they were unable to obtain equal facilities in England, as well as the French, who have hitherto rarely studied abroad, and the Japanese.

THE Civil List pensions granted by the British government during the year ended March 31 last, includes, as we learn from *Nature*, the following: Mrs. Edith Harrison, in consideration of the services rendered by her late husband, Colonel W. S. Harrison, in connection with inoculation against enteric and typhoid fevers, £50; Mrs. Cash, in view of the contributions of her late husband, George Cash, to the study of Scottish topography, £50; Mr. William Cole, in view of his contributions to the study of natural history and to scientific education, £50; Mrs. R. O. Cunningham, in view of the services of her late husband, Professor Cunningham, as naturalist on board H.M.S. *Nassau* during the survey of the Straits of Magellan and the west coast of Patagonia, and as professor of natural history in Queen's College, Belfast, £50; Mr. Benjamin Harrison, in view of his devotion to scientific work (in addition to his pension of £26 a year), £25; Mrs. E. A. Mettam, in view of the distinction of her late husband, Professor A. E. Mettam, as professor of pathology and bacteriology, and of his contributions to veterinary science, £75; Miss Helen Tichborne, in view of the late Professor Tichborne's scientific discoveries in chemistry and pharmacology, £60; Miss Eliza Standerwick Gregory, in view of her eminent services to botanical science, £60, and Lady Eleanor Charlotte Turner, in view of her late husband, Sir George Turner's services in the investigation and prevention of rinderpest, and in consideration of his death through contracting leprosy in the public service, £50.

## UNIVERSITY AND EDUCATIONAL NEWS

BENNO LOEWY, a lawyer, has left the residue of his estate, said to amount to $250,000, in trust to his wife, to revert to Cornell University after her death. He gave his collection of stamps, pamphlets, engravings and illustrations to Cornell for immediate possession.

THE Connecticut state appropriations for the agricultural stations were increased by the last legislature. For the ensuing biennium the State Station will receive $45,000, an increase of $7,500, and the Storrs Station $25,000, an increase of $10,000.

DR. EDWARD G. BORING, recently of Cornell University, has been appointed professor of experimental psychology and head of the psychological laboratory at Clark University, to succeed the late Professor Baird. The staff of the department of experimental psychology will consist of Professor Boring, Professor Samuel W. Fernberger and Mr. Carroll D. Pratt.

THE department of forestry in Colorado College, which was suspended for the period of the war, is being revived under the charge of Mr. Gordon Parker, M.F. (Harvard), who has had charge of the Montezuma National Forest as supervisor for the past five years.

DR. HERMAN L. IBSEN, formerly connected with the University of Wisconsin, has been appointed assistant professor of animal genetics at the Kansas Agricultural College.

W. S. NELMS, Ph.D. (Columbia, '13), has been elected associate professor of physics, in charge of the department, of Emory University, in Atlanta, Georgia. He has been recently discharged from the army in which he was a first lieutenant in the technical staff of the Ordnance Department.

Dr. L. Bauman, formerly assistant professor of medicine and director of research, at the University of Iowa has been appointed associate in medicine at Columbia University and assistant visiting physician to the Presbyterian Hospital.

The following appointments to professorships in the University College of Wales, Aberystwyth, have been made: Professor G. Owen, of the University of New Zealand, in physics; Professor W. H. Young, of the University of Liverpool, in mathematics; A. E. Jones, of the University of Wales, in agriculture; Captain W. T. Pugh, in geology.

## DISCUSSION AND CORRESPONDENCE

### A POSSIBLE SOURCE OF COSMICAL ENERGY

According to the theory of J. J. Thomson, atoms are complex structures of systems of positively and negatively charged particles (such as, *e. g.*, helium nuclei and electrons) in rapid rotation and held in position by an equilibrium of their mutual forces.

Various phenomena can be explained and a possible source of cosmical energy be found by the simple assumption that some constituents of the subatomic structure retard their speed in eons and thereby increase the weight of the atoms.

It was recently pointed out[1] that the different atomic weights of the isotopes, such as, *e. g.*, the different forms of lead, may be due to "age" of the chemical elements, whereby the different types of atoms are subject to a chemical evolution. In the case of lead the radioactive or young lead possesses the lower atomic weight and density than the common or old lead. According to this hypothesis the radioactive, that is newly formed, lead will eons hence have a higher atomic weight and density, while the common or old lead had eons ago a lower atomic weight and density. All other elements should be subject to this aging process, and by the catching of further electrons and helium nuclei transmute into elements of higher atomic weight. Evidence of this is seen in the occurrence of the chemical elements and their distribution upon the earth's surface, where elements of the same period are mostly aggregated in definite mineral types.

Assuming that the orbital motion of the electrons is lessened in a certain time interval, it is evident that a steady and continuous amount of energy apparently disappears. This energy perhaps reappears as cosmical energy, for the principle of conservation makes it inconceivable that such a steady drainage of energy should be constantly wasted.

If such a theory is substantiated, a link between the extreme sciences of the macrocosmos and microcosmos, astrophysics and subatomic physics, will be established and stellar evolution will be based upon a chemical evolution whereby all types of atoms change until they finally become radioactive, that is unstable, and disintegrate again. The smoke-rings of some planetaries are then perhaps clouds of helium gas formed by the radioactive disintegration of the nuclear star, and would thus indicate the last stage of chemical and stellar evolution and the beginning of a new series.

Ingo W. D. Hackh

Berkeley, Calif.

[1] Science, 49, 328, 1919.

### THE IMPERFECT STAGE OF LEPTOSPHÆRIA TRITICI OF WHEAT

In connection with studies of anthracnose of small grains a species of what seemed to be an *Ascochyta* has frequently been found on dead straw. Recently, while culturing *Leptosphæria tritici* the relationship of these two forms was revealed.

The pycnidial fruiting bodies grow side by side with the perithecia of *L. tritici* on dead wheat straw in the spring and are difficult to distinguish from them, both being dark, submerged and of the same size, though the ostioles of the perithecia are more protruding. The pycnidia are filled with guttulate spores, usually two-celled and approximately 12–20 $\times$ 3.5–4 $\mu$, their shape, size and manner of production suggesting *Ascochyta graminicola* as described by Frank. Single spore cultures of the ascospores of *L. tritici* obtained by the

Hansen method of isolation, produce on potato agar and on sterile straw, pycnidia and pycnospores like those found growing with the perithecia on the wheat plant.

L. W. DURRELL
IOWA AGRICULTURAL EXPERIMENT STATION,
AMES, IOWA

## SCIENTIFIC BOOKS

### A BRIEF SURVEY OF SOME RECENT CHEMICAL LITERATURE

NOTWITHSTANDING the extraordinary demands which have been made upon the chemists of this and other countries during the recent years, there has been a considerable number of contributions to chemical literature. It has, however, also been a period in which reviewers were difficult to secure and the editor's table has accordingly been filled with an accumulation of material which the writer has been asked to pass in brief review. He has regretfully to confess to responsibility for a further considerable delay in the accomplishment of the undertaking. As a result, a number of the titles mentioned below will be recognized as already familiar; but it may, nevertheless, be useful to recall them.

In the field of inorganic chemistry Alexander Smith's "Inorganic Chemistry" (The Century Co.) has appeared in its third edition, in which the well-known character of that work is strictly maintained, the changes being chiefly those of amplification. Other standard texts which have recently appeared in revised form are: Holleman-Cooper's "Text-book of Inorganic Chemistry" (5th edition, John Wiley & Sons); Newell's "Inorganic Chemistry for Colleges" (D. C. Heath & Co., 2d edition), and Cady's "Inorganic Chemistry," which has appeared in a simplified form, under the title "General Chemistry" (McGraw-Hill Book Co.). In none of these has there been any marked change in the manner in which the subject is treated. Professor H. G. Byers, of the University of Washington, has contributed an interesting new volume ("Inorganic Chemistry," Charles Scribner's Son's) which is more or less frankly constructed along the lines of Alexander Smith's texts, and, in scope, lies between his "College Chemistry" and the larger work mentioned above. It is rather a pity that the publishers saw fit to dress this material in a garb so exactly like that of Professor Smith's books that, in appearance of the printed page, the books are indistinguishable, which creates an unwarranted impression of reproduction of material, in view of the general similarity of treatment.

In the "Principles of Chemistry" of Dr. Joel H. Hildebrand (The Macmillan Co.) there is to be found a volume which has real freshness and originality of treatment of its subject matter. With a minimum of descriptive matter, for which the student is referred to existing texts, the fundamental concepts are clearly stated and well illustrated for beginners. The book contains much for the consideration of thoughtful teachers.

Two texts for secondary schools are to be found in the editor's collection, one by Dr. B. W. McFarland, of New Haven ("A Practical Elementary Chemistry," Charles Scribner's Sons), which presents a thoughtfully arranged course of instruction in which the laboratory forms the central feature, and another by Charles E. Dull, of Newark ("Essentials of Chemistry," Henry Holt & Co.), which has appeared since the beginning of the war and in which particular stress is laid on the importance of the science, through the use, as examples, of the chemistry of common things.

Laboratory manuals to accompany the texts of Newell and of Byers have been issued by the publishers of these texts; also one to accompany the well-known text-book of McPherson and Henderson (Ginn & Co.). Other manuals by W. A. Noyes and B. S. Hopkins (Henry Holt & Co.), W. J. Hale (The Macmillan Co.) and W. M. Blanchard (D. Van Nostrand Co.) make no reference to any specific text. All of these manuals are carefully prepared, and while each has some particular points of excellence, the material is presented along well-recognized lines. The "Laboratory Study of Chemistry," by H. R.

Smith and H. M. Mess (Henry Holt & Co.), on the other hand, is out of the ordinary. The authors combine with the directions for experimentation a large amount of interesting information, much of which is not to be found in the ordinary text-books, but which should serve to awaken scientific curiosity and stimulate interest in the work itself. The scheme of instruction as laid down is exacting and calls for teaching of a high order. Whether or not one cares to adopt the procedure as a whole, the book will be found to be full of helpful suggestions and well worth study.

In the field of organic chemistry, the well-known "Organic Chemistry for Advanced Students" of Professor J. B. Cohen (Longmans, Green & Co.) appears in a second edition, in which the material formerly included in two volumes is divided into three, dealing, respectively. with "Reactions," "Structure" and "Synthesis," with the purpose of grouping together to better advantage allied subjects and affording a more logical sequence. The rearrangement of the subject matter has given opportunity to bring the material up to date, and the new volumes seem to fully maintain the standard of the earlier edition as one of the notable works on organic chemistry. The book is written for advanced students and is not designed to have the sort of completeness which belongs to a work of reference, although these volumes will be found valuable in that respect as well. Professor Cohen had also prepared somewhat earlier a "Class-book of Organic Chemistry" (The Macmillan Co.) designed for medical students, and others who are not intending to make chemistry a profession, which merits attention as a carefully planned and simplified course.

Professor J. T. Stoddard's "Introduction to Organic Chemistry" (P. Blakiston's Son & Co.) has appeared in a second edition and Professor E. P. Cook has prepared a little manual entitled "Laboratory Experiments in Organic Chemistry" to accompany it. Both are characterized by a simplicity and directness of statement which is welcomed by beginners.

Among the text-books on analytical chemistry which have appeared during the last few years are to be found several new editions of well-known works. These include a fourth English edition of Treadwell-Hall's "Analytical Chemistry, Volume II., Qualitative Analysis" (John Wiley & Sons), a standard authority; a sixth edition of A. A. Noyes' "Qualitative Analysis" (The Macmillan Co.), a manual based upon what is, perhaps, the most painstaking and thorough series of investigations ever undertaken as a background for the perfection of analytical procedures; and a second edition of Mahin's "Quantitative Analysis" (McGraw-Hill Book Co.), a manual which has already received deserved recognition. A less familiar manual which is in its second edition is that by Edmund Knecht and Eva Hibbert, entitled "New Reduction Methods in Volumetric Analysis" (Longmans, Green & Co.). It is of the nature of a monograph, dealing almost wholly with the applications of titanous chloride as a quantitative reducing agent. Other recent works in their first editions include an "Elementary Qualitative Analysis" by Professors Dales and Barnebey (John Wiley & Sons), a straightforward presentation of the subject, but without striking features; "Methods in Metallurgical Analysis," by Professor C. H. White, a work of somewhat uneven merit (D. Van Nostrand Co.); "An Advanced Course in Quantitative Analysis," by Professor Henry Fay (John Wiley & Sons), another manual based upon a long series of investigations; and a "Volumetric Analysis," by A. J. Berry (Cambridge University Press, England), a manual prepared for a college course in analytical chemistry, in which the general discussion of the subject appears to excel the directions for analysis.

Teachers of stoichiometry are already familiar with Dr. R. H. Ashley's "Chemical Calculations" (D. Van Nostrand Co.), of which a second edition has recently appeared. Errors have been corrected, but no change has been made in the subject matter.

Along the lines of what is commonly known as physical chemistry, the editor's collection

included the following: "Outlines of Theoretical Chemistry," by Dr. F. H. Getman (John Wiley & Sons), which is in its second edition and has been revised and enlarged, notably with respect to atomic structure, colloids, electromotive and photochemistry which has, no doubt, added to the usefulness of a work already respected. The literature relating to colloids has been extended by a second edition of Dr. M. H. Fischer's translation of Wolfgang Ostwald's "Handbook of Colloid-Chemistry" (P. Blakiston's Son & Co.), to which "Notes" have been added by Emil Hatschek, but without essential change in the nature of the material. A further new work is that entitled "The Chemistry of Colloids," by Dr. E. B. Spear (John Wiley & Sons), Part I. of which is a translation of Zsigmondy's "Kolloidchemie," and Part II. is on "Industrial Colloidal Chemistry," written by Dr. Spear, with a chapter on "Colloidal Chemistry and Sanitation," by Dr. J. F. Norton. The subject is brought up to date in an easily readable fashion and is of interest to both the general and technical reader. Dr. F. P. Venable in his "Brief Account of Radio-activity" (D. C. Heath & Co.) has contributed in about fifty pages an entertaining and somewhat popularized summary of the phenomena of radioactivity and their influence upon our notions of atomic structure.

The editor's table contained but one volume on industrial chemistry, now become familiar, namely, Dr. Allen Roger's "Elements of Industrial Chemistry" (D. Van Nostrand Co.), an abridgment of the larger work by Rogers and Aubert. Both have an established place in chemical literature.

The fact that Dr. Phillip B. Hawk's "Practical Physiological Chemistry" (P. Blakiston's Son & Co.) has reached its sixth edition is sufficient evidence of its usefulness in "schools of medicine and science" for which it was written. The entire work has been revised and brought up to date.

"The Chemistry of Farm Practice," by T. E. Keitt, which is included in the Wiley Technical Series, has for its purpose the imparting of a "knowledge of the fundamental chemistry required for intelligent agriculture" and its applications to the art and to the problems of the agriculturist. The story is told in non-technical language. In the same field there has appeared a "Laboratory Manual of Agricultural Chemistry" by Hedges and Boyant which is apparently a useful little book for agricultural institutions, although open to some criticism as to the accuracy of some of its methods for the standardization of volumetric solutions.

A distinct contribution to contemporary literature is to be found in Dr. F. J. Moore's "History of Chemistry" (McGraw-Hill Book Co.). a volume which holds the interest alike of the layman and the scientist, and deals with its subject in a scholarly fashion.

In line with the current effort to supplant German reference works by English equivalents, "The Chemist's Year Book" for 1918–1919, edited by F. W. Atack (Sherratt & Hughes, London), is worthy of note. The present is the fourth edition of this work and is the result of a thorough revision of the last edition. It seems to deserve a place in all laboratories and libraries.

Finally, and again in line with the trend of the times, is a volume entitled "Chemical French" by Dr. Maurice L. Dolt (Chemical Publishing Co.). The author seeks to enable students who have little or no previous knowledge of French to read chemical literature in that language through the medium of this volume and, accordingly, includes instruction in grammar in the earlier portions. The latter portion is devoted to selections from standard and current journal literature. The book contains 398 pages, a length which seems to be somewhat out of proportion in an auxiliary work of this sort; otherwise it is likely to render real service.

H. P. TALBOT
MASSACHUSETTS INSTITUTE OF TECHNOLOGY,

## ORGANIZATION OF THE AMERICAN SECTION OF THE INTERNATIONAL GEOPHYSICAL UNION. II

The first general meeting, for preliminary organization, of the American Section of the

proposed International Geophysical Union, was held in three sessions on June 24 and 25, 1919.

FIRST SESSION

The sad loss sustained by the section in the death of Professor Joseph Barrell was announced by the acting chairman, Mr. Wm. Bowie.

The acting chairman made a brief statement concerning the purpose of the section, and gave a short sketch of the several meetings previously held in connection with founding the section.

The following business was transacted.

It was decided that the officers and members of the section, and of the Provisional Executive Committee, temporarily appointed in the section by the Division of Physical Sciences, and by the Provisional Executive Committee, shall stand and hold office until the meeting of the section for permanent organization after the Brussels conferences, which have been scheduled to begin July 18, 1919.

The section accepted the proposal of the Division of Physical Sciences that it act as the Committee on Geophysics of the division.

The section is concerned with national as well as international problems in geophysics.

For the purpose of accomplishing the objects of the section the Executive Committee is authorized to appoint from time to time special committees to deal with problems of national or international character.

In the permanent organization of the American Section there shall be a chairman, a vice-chairman, a secretary, and an executive committee, of which the three officers mentioned above shall be ex-officio members.

The members of the section who go to the Brussels meeting are constituted a committee, with power to add to its membership, to consider permanent organization of the section. After preparing a plan for organization this committee is to report to a meeting of the section, to be called at the discretion of the acting chairman, for the purpose of perfecting the permanent organization.

A committee of three, consisting of Messrs. Brown, chairman, Hayford and Humphreys, was appointed to make recommendations to the section for increasing its membership by the addition of men of science engaged in geophysical work or work in affiliated subjects, who would strengthen the section and provide cross-connections with various branches of science in which the section is directly interested.

The statements in regard to the past history, present status and scientific purposes of the specified international scientific organizations were presented and accepted.

After a brief discussion it was found to be the sense of the meeting that neutrals should be admitted to the International Geophysical Union.

Attention was called to certain international organizations not previously specified in the discussions of the committee which it was thought desirable to have affiliated with the International Geophysical Union.

The following delegates and alternates recommended for election by the Executive Committee were approved and elected:

Messrs. L. A. Bauer, Wm. Bowie, A. O. Leuschner, G. W. Littlehales, C. F. Marvin, H. F. Reid, H. C. Graves, J. T. Watkins, Captain Edward Simpson, the three latter also being delegates to the London Hydrographic Conference; and as alternates, Messrs. W. J. Humphreys, J. F. Hayford, W. J. Peters.

A report of the Committee on Variation of Latitude, carrying the following recommendations, was approved:

1. That the observations for variation of latitude, their reduction, and their publication be intrusted to the International Astronomical Union.

2. That the continuity of the observations by the present methods at the four international variation of latitude stations, Ukiah, California; Carloforte, Italy; Mizusawa, Japan, and Charjui, Turkestan; be maintained, as far as practicable, and that the matter of utilizing the observations made at other stations be considered.

3. That the question of renewing variation of latitude observations in the southern hemisphere be considered.

4. That, inasmuch as no definite plan can be advanced for defraying the expense of the variation

of latitude work until some international arrangement is formulated, the several nations maintain the stations within their domains, and that some provisional arrangement be made for caring for the records, reductions and publications, pending a permanent organization of the work.

A report of the Committee on Publications, carrying the following recommendation, was approved:

That all *Titles* in geophysical subjects should be printed in *Science Abstracts*, Section A (Physics), probably best under a special, appropriately entitled section, with *abstracts* of all papers suitable for this journal and drawn up in accordance with the procedures uniform in it.

The appointment of Messrs. Michelson, chairman, Chamberlin, Moulton as a Committee on the Investigation of Earth Tides was approved.

The question of the formation of a separate group, or "sub-section," to represent geochemistry was left to the delegation to Brussels.

The section adopted the plan for voting at Brussels which had been adopted by the American Section of the proposed International Astronomical Union, embodied in the following two motions:

*Moved:* That it be the sense of the section that on questions of policy which come up in Brussels a caucus be held and the delegation vote as a unit. *Adopted.*

*Moved:* That it is the opinion of the section if the organization of the union does not conflict that votes on technical matters may be cast by delegates designated by the chairman. *Adopted.*

A suggestion presented by letter from Dr. W. F. G. Swann, regarding the position of "terrestrial electricity" in the subdivision of the geophysical field was referred for consideration to the meetings at Brussels.

A report of the Committee on the Investigation of Earth Tides was read, discussed, approved and referred to the delegation for presentation to the Brussels meeting. This report is included here as an appendix.

Messrs. Henry G. Gale and Wm. D. MacMillan were added to the Committee on the Investigation of Earth Tides.

SECOND SESSION

*Joint Session with American Section, International Astronomical Union.*

The meeting was presided over by Mr. W. W. Campbell, chairman of the American Section, International Astronomical Union.

Dr. R. S. Woodward addressed the meeting on the general aspects of geophysics and its affiliations and subsequently prepared an abstract of his remarks for the use of the delegation at Brussels.

There was a brief general discussion of the functions of the delegation abroad and of the need of guarding as effectively as possible against legislation tending to exclude any legitimate interests from the international organizations.

Mr. Leuschner gave an account of the origin, relationships and functions of the proposed international cooperative efforts, the progress made toward reorganization, and the further effort required.

The chairman of the American delegates, Mr. W. W. Campbell, was formally authorized to call joint meetings of the delegations of the Sections in Astronomy and Geophysics at his discretion.

After discussion of the report of the Committees on the Variation of Latitude, it was stated as the sense of the joint meeting that an international committee to deal with problems of variation of latitude should be formed.

THIRD SESSION

The Committee on Nominations for additional members of the section—Mr. Brown, chairman, presented the following names and these gentlemen were elected: Messrs. C. G. Abbot, L. J. Briggs, A. J. Henry, L. M. Hoskins, C. E. Van Orstrand, J. B. Woodworth; and upon nomination from the floor, Messrs. A. G. Mayor, R. DeC. Ward and W. J. Peters were also elected.

For the guidance of the delegates to Brussels the document entitled "Proposals for the Convention for an International Union of Geophysics—Approved by the Council of the Royal Society," was read by paragraph and article and votes of instruction were taken.

Three specific research projects presented by letter by Mr. R. A. Daly were then considered, which may be briefly entitled: "(1) A Systematic Thermometric Study of the Gulf Stream, (2) Improving of the Deep Sea Thermograph, and (3) Continued Study of the Composition of Volcanic Gases." These were referred to the Executive Committee.

A brief outline of a statement of the problems of seismology was given by Mr. Wood. This document was referred to the delegation to Brussels and to the Executive Committee.

Mr. Bowie read a brief statement on isostasy and its relationships.

Mr. Bigelow made mention of work planned for exploration in the North Atlantic and the desirability of having this undertaking affiliated with the International Geophysical Union.

Mr. Marvin made reference to the need of centralization in the work of meteorological bureaus, and internationally.

Harry O. Wood,
*Acting Secretary*

APPENDIX: REPORT OF THE COMMITTEE ON INVESTIGATION OF EARTH TIDES

*To the American Section of the International Geophysical Union:*

Your Committee on Earth Tides begs to report as follows:

1. *Recommendation.*—It is recommended that earth-tide experiments be carried out as soon as possible at stations in (1) Pasadena, California; (2) some island in the central Pacific; (3) the interior of Argentine; (4) England; (5) the interior of Africa; and also, if possible, (6) the interior of India; (7) Japan; (8) Italy; and (9) near Hudson's Bay. It is recommended that the method be that employed at Williams Bay, Wis., in 1915–16, and that the experiments extend over a period of one year.

The reason for the recommendation that the experiments be carried out both inland and near the coast is that it is desired to determine and to eliminate the efforts of the ocean tides on the general tidal deformations of the earth. The reason for the recommendation that two stations be in the southern hemisphere, is that it is desired to determine whether or not the two hemispheres of the earth differ in their deep interiors as they do in their surface features.

2. *Results to be Obtained.*—The proposed experiments will determine the magnitudes of the tidal deformations of the earth of various periods from the semi-daily to the semi-annual within about one tenth of one per cent., and will determine the phases of the principal tides within one minute of time. These results are of an order of accuracy that leaves nothing to be desired. It is possible to determine from the magnitudes of the earth tides the stiffness of the earth, considered as a whole, with a corresponding degree of accuracy; and to determine from the phase relations of the tides to the tide-raising forces whether the earth yields as a viscous or as an elastic body, or to what extent it is elastico-viscous, to use Sir George Darwin's term.

The foregoing results are deemed important for the following reasons:

(*a*) They give reliable information about hitherto almost unknown properties of the earth.

(*b*) They throw some light on the effects of enormous pressures on the properties of matter.

(*c*) They enable us to determine accurately the present rate of tidal evolution.

(*d*) They give the geologist a secure basis for theories regarding earth deformations, at least at the present time.

(*e*) They have important relations to doctrine of isostasy.

(*f*) They form a necessary preliminary to a complete treatment of ocean tides.

(*g*) They are valuable in connection with theories respecting the origin of the earth.

3. *Cost of Experiments.*—The cost of the installation of the necessary apparatus for the experiments will be about two thousand dollars for each station, and the expenses of maintenance for a year and the securing and measuring of the records will be about four thousand dollars additional. That is, the total cost of each station will be about six thousand dollars.

4. *Type of Apparatus and Personnel.*—It is recommended that all stations use apparatus of identical type, namely, that employed at Williams Bay, Wis., in the second series of experiments of 1915–16. This will insure that all the results will be comparable, at least so far as they depend upon the apparatus.

It is recommended that the experiments be carried out simultaneously, or at least that they largely overlap in time, so that any general seismic or other possible disturbances may not lead to erroneous conclusions respecting differences in the properties of the earth in widely different parts.

It is recommended that the stations be so located, if possible that the greater part of the work of securing and measuring the films may be done by local scientists. On the other hand, it is recommended that the installation of the apparatus be supervised by those who have devised it and had experience with it. It is recommended that all the details of securing the records, measuring the films, and making the calculations be entirely homogeneous and under the supervision of those who have already perfected them.

Committee of the American Section of the International Geophysical Union on Earth Tides,

A. A. MICHELSON, *Chairman*,
F. R. MOULTON,
T. C. CHAMBERLIN

## SPECIAL ARTICLES

### RESEMBLANCES BETWEEN THE PROPERTIES OF SURFACE-FILMS IN PASSIVE METALS AND IN PROTOPLASM. I

IN my recent comparison of protoplasmic transmission with the transmission of activation in passive metals.[1] I reviewed evidence indicating that in both cases the effect is dependent upon the properties of the thin film of impermeable or protective material formed or deposited at the interface between the metal, or the protoplasm, and the adjoining electrolyte solution. In the passive metal the composition and physical properties of this thin layer are such that it is very readily and rapidly altered or removed by the electrochemical action of the local circuits which appear wherever the film is locally interrupted or its permeability increased beyond a certain limit. The originally continuous and homogeneous film (of oxide or oxygen compound) may thus be removed by electrolytic reduction at the local cathode; a new local circuit is then automatically formed at the boundary between this reduced or activated region (where metallic iron is exposed) and the film-covered or passive area beyond, which forms the cathode of the circuit; a similar process is there repeated; and in this manner the active state is propagated over the whole surface of the metal. Similarly in the living system, *e. g.*, nerve-axone (according to the local action theory of protoplasmic transmission), the surface-film or plasma-membrane is locally altered or interrupted in an analogous manner by the action of the local bioelectric circuit formed between the region of excitation and the resting region beyond; at this latter region, where the current (positive stream) of the circuit passes from the protoplasmic surface to the medium, it produces, primarily through some local process of electrolysis, a change—the critical or excitatory change—in the structure and electromotor properties of the surface-film, this change being apparently associated with an interruption of continuity or increased permeability; a new circuit then arises at the boundary between this newly altered or activated area and the adjacent still unaltered area; and by a repetition of this process at each new active-resting boundary as it is formed, a wave of chemical and physical alteration, associated with a local electrical circuit, travels over the surface of the irritable element. This wave constitutes the excitation-wave, or nerve impulse in the case of the nerve-axone. Since by its very nature this wave is always associated with a local electric current, it produces the effects of electrical stimulation wherever it extends, hence also in the irritable structure, *e. g.*, muscle-cell, at which the axone terminates.

This theory postulates an essential similarity in physicochemical properties and constitution between the surface-films of passive metals and the protoplasmic surface-films or plasma-membranes of the irritable living cells or cell-structures. Certain general resemblances are apparent: both types of film are water-insoluble, are formed by chemical alteration (typically involving oxidation) of the surface-layer of the metal or protoplasm, are impermeable or difficultly permeable to the electrolytes of the adjoining solution, and are subject to ready alteration under the influence of electric currents formed by local action. In consequence of this latter condition such films are often unstable and subject to com-

[1] SCIENCE, N. S., 1918, Vol. 48, p. 51; *cf.* also my general article on "Protoplasmic Transmission," *Scientific Monthly*, 1919, Vol. 8, pp. 456, 552.

plete and rapid dissolution as a result of slight local mechanical and chemical alteration; any interruption of continuity sets up a local circuit and initiates a process of dissolution which may be propagated over the whole surface and result in the complete destruction of the film; many living cells (*e. g.*, blood corpuscles) are thus unstable, as is also the passive state of a metal like iron in most solutions. Accordingly, unless the film is automatically restored whenever it is interrupted, the state of passivity in a metal, such as iron, or of continued life in a living cell, is temporary and never lasts long. A special peculiarity of such systems, however, is that when the passive metal is immersed in a suitable oxidizing solution, or the living cell in its normal medium, the continuity of the film is preserved by an automatic regulatory process of the type just indicated; and under such conditions the passive or the living condition may be a highly stable one. Automatic reversion to the passive or resting condition is in fact the rule in metals or in irritable elements under certain conditions. This peculiarity is an especially important one from the physiological standpoint, and its basis will be further considered below.

If, as the local action theory of stimulation would imply, the control of protoplasmic processes is largely dependent upon the peculiar properties and behavior of surface-films of this type, it is clear that the general physics and chemistry of such films must be a matter of fundamental interest for general physiology. Although the films formed upon metallic surfaces are obviously widely different in their chemical composition from those enclosing irritable living elements like muscle-cells or nerve-fibers, they nevertheless exhibit in their general physical properties, conditions of formation and behavior many close resemblances to the latter. And it is just those properties which both types of film possess in common that determine the most characteristic features of their behavior, in particular their "irritability" and their power of transmitting chemical influence to a distance. These are the properties which are of most general physiological interest, and they are dependent upon simple conditions of a general kind, which are in no way peculiar to living protoplasm but are present in varying degree at all boundary-surfaces across which the transfer of electricity in association with chemical change (electrolysis) can take place.

The surface-film of passive iron is especially suitable for study from the above point of view because of the readiness with which it is formed and its marked sensitivity to mechanical and electrical influences; in these and other respects it exhibits a behavior closely analogous to that of the protoplasmic surface-films of irritable cells and cell-elements. The experiments about to be described have aimed at determining the degree to which these analogies extend to other peculiarities of behavior, and in particular whether definite correspondences exist in regard to the influence of electrolytes and surface-active organic compounds upon the stability and other properties of the film. Both of these classes of compounds have a well-known and characteristic influence on protoplasmic irritability, a property which is undoubtedly dependent upon the state of the surface-films or plasma-membranes of the irritable elements.

*Self-conserving Properties of the Film.*—An automatic power of repair is a highly characteristic property of protoplasmic surface-films; slight wounds or interruptions of the cell-surface are repaired; more extensive injury frequently leads to a rapid breakdown of the entire cell. The normal return of a living irritable element to the resting state after stimulation, or cell-division, or other change associated with alteration of the plasma-membrane, appears to depend mainly upon this ability to reform the surface-film. In irritable tissues (muscle, nerve) the time required for this restorative process apparently corresponds with the temporarily insensitive or "refractory" period immediately following excitation, whose duration (as is well known to physiologists) is in general briefer the more rapid the response of the tissue to excitation. Rapid response and rapid recovery are thus constantly associated properties of an irritable tissue. A similar automatic restoration of the passivating surface-film after activation

takes place in an iron wire immersed in a strongly oxidizing solution like concentrated nitric acid, and is similarly associated with a return of the original sensitive or *quasi*-irritable properties of the film; this recovery is also attended with a certain delay, analogous to the refractory period of the protoplasmic system. In this automatic return of passivity both the general oxidizing action of the solution and the electrochemical oxidizing influence at the local anodic regions of the metallic surface are factors.

Iron wires which have previously been rendered passive will frequently retain their passivity for an indefinite time, if left undisturbed, in solutions whose oxidizing powers are insufficient to impart passivity to already active wires. This is the case, for example, in solutions of nitric acid of less than 1.2 s.g.; in such solutions passivity remains unaltered for an indefinite time, provided the continuity of the surface-film is not interrupted (by mechanical or other means) over a sufficiently great area. But activity, once it is established, is permanent and the metal dissolves in the acid. As a rule, extensive scraping or vigorous jarring is required to activate mechanically a passive iron wire immersed in 1.2 $HNO_3$, although different specimens of iron vary in sensitivity. Apparently if the total area of metallic surface which is thus freed from film and exposed to the direct action of the acid is less than a certain critical minimum, the local anodic action quickly reforms the film, and the wire as a whole continues to exhibit passivity. Hence a single scratch with a glass rod may be ineffective, while if several scratches are made simultaneously or close together the total or summated effect may be sufficient for activation. This behavior throws light upon the general nature of summation-effects in film-covered systems of this class, which include living protoplasm as well as passive iron. Destruction of a sufficient area of surface-film is followed by a rapidly propagated wave of activity which destroys the whole film and renders the whole metal active. Thus the physiological distinction between the "local change" and the "propagated disturbance" in irritable tissues, familiar to physiologists from the work of Keith Lucas and others, is exemplified in the behavior of such wires. Any alteration of the film affecting less than a certain critical area fails to propagate itself and involve the whole surface. Apparently the ratio $\frac{\text{active area}}{\text{passive area}}$ must exceed a certain critical minimum if the activating effect is to gain the predominance and involve the whole surface of the metal; otherwise the entire surface resumes the passive state. Local conditions of either passivity or activity are equally capable of spreading; and the final state of the system as a whole depends upon whether the one or the other condition gains the upper hand. The tendency to revert to passivity after local disturbance varies in different metals and in different specimens of the same metal; for example, in nickel (in 1.2 $HNO_3$) it is much greater than in iron. Hence the local state of the surface at any time is determined by the relative intensity of the two opposed processes, one of which tends to form and the other to destroy the surface-film. A similar statement holds true of the protoplasmic systems; in the maintenance of any living structure constructive or "anabolic" processes are continually at work, which compensate or offset the continually acting destructive processes; this applies to the surface-film as well as to other protoplasmic structures.

Another simple observation, continually repeated in these experiments, indicates still further the active or self-regulating character of the process by which the surface-film of passive iron is preserved intact in an oxidizing solution (*e. g.*, 1.20 $HNO_3$) in spite of minor disturbances or local alterations in the film. All solutions of chlorides rapidly destroy passivity, at a rate which is approximately proportional to the concentration of the Cl-ions; usually in the wires used in the following experiments an exposure of 8 or 10 seconds to $m/1200$ NaCl or KCl is required to render a passive wire reactive to 1.20 $HNO_3$. When, however, such a wire is exposed to the salt solution for less than this critical period, *e. g.*, for 6 seconds, and is then dipped momentarily

in 1.20 $HNO_3$, washed in distilled water, and again placed in the salt solution, it is found that the time now required for activation is not shorter but is essentially the same as before, *i. e.*, 8 to 10 seconds. Evidently the brief exposure to the acid has restored the partly altered film to its original condition. But if the process of alteration in salt solution is allowed to pass the critical stage (with, *e. g.*, 10 seconds exposure) before transfer to the acid, the latter has no passivating action, and the wire continues to react until completely dissolved. This observation shows that the progressive modification which the film undergoes in the salt solution is of a kind which is rapidly and completely reversible if the metal is returned to the acid before a certain critical stage is reached; but after this stage is once passed the whole film breaks down when the wire is replaced in acid and the iron is no longer protected against solution. This behavior resembles that of living cells after transfer from a balanced salt-solution like sea water to a toxic solution like pure *m*/2 NaCl, as shown (*e. g.*) in Osterhout's experiments with *Laminaria;* the cells undergo a progressively injurious modification associated with an alteration in the properties of the plasma-membranes, shown by increasing permeability; this change may be reversed by transfer to the original medium before, but not after, the modification has reached a certain critical stage. Thus the characteristic power, normally possessed by the living plasma-membrane, of preserving intact its continuity and semi-permeability is simulated in a general manner by the behavior of the surface-film of passive iron in dilute nitric acid.

The action of salt-solutions upon those surface-films (influence of nature and concentration of salts, relative rates of action of different salts, antagonisms) will be described more fully in the second part of this article.

Ralph S. Lillie

## SOCIETIES AND ACADEMIES

### THE NORTH CAROLINA ACADEMY OF SCIENCE

The annual meeting of the North Carolina Academy of Science was held at Trinity College, Durham, on May 2 and 3.

The presidential address was given by Dr. E. W. Gudger on "On an extraordinary method of fishing—the use of remora for catching fish and turtles."

The following papers were presented:

*Undamped electrical oscillations:* C. W. Edwards.
*A portable printing outfit for the ecologist:* Z. P. Metcalf.
*Sanitation in the south:* Thorndike Saville.
*Some generic distinctions in sponges:* H. V. Wilson.
*A magnetic paradox:* F. N. Edgerton, Jr.
*Vegetation in the closing of ponds with special reference to the Kamaplain ponds of Wexford county, Michigan:* Collier Cobb and H. D. House.
*Preliminary studies of the reproduction rate of Copepoda:* Fannie E. Vann.
*Deposits of volcanic ash:* John E. Smith (by title).
*Asymmetry in the formation of the nervous system in the frog embryo:* Blackwell Markham.
*Recent mosquito control work in North Carolina:* R. W. Leiby.
*Reptilian folklore:* C. S. Brimley.
*New or little known diatoms from Beaufort, North Carolina:* J. J. Wolfe.
*Some notes on Protozoa:*
(a) *Occurrence of Tintinnus serratus Kofoid in Chesapeake Bay.*
(b) *Arcella excavata nov. sp.:* Bert Cunningham.
*The ovary of the Gaff-topsail catfish, Felichthys felis:* E. W. Gudger.
*The seventeen-year locust in North Carolina in 1917:* Z. P. Metcalf.
*Our rats, mice and shrews:* C. S. Brimley.
*The high frequency electric furnace:* F. N. Egerton, Jr.
*The felsites of Mount Collier:* John E. Smith (by title).
*The inland waterway from Boston to Beaufort:* Collier Cobb.
(a) *A new parasitic blue-green alga.*
(b) *Comparison of Rhododendron catawbiense with a form occurring at Chapel Hill:* W. C. Cooker.
*Locating invisible objects:* C. C. Hatley.

Bert Cunningham,
*Secretary*

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter